# Navy
# Conceptual Models of the Mission Space (CMMS)

prepared by:

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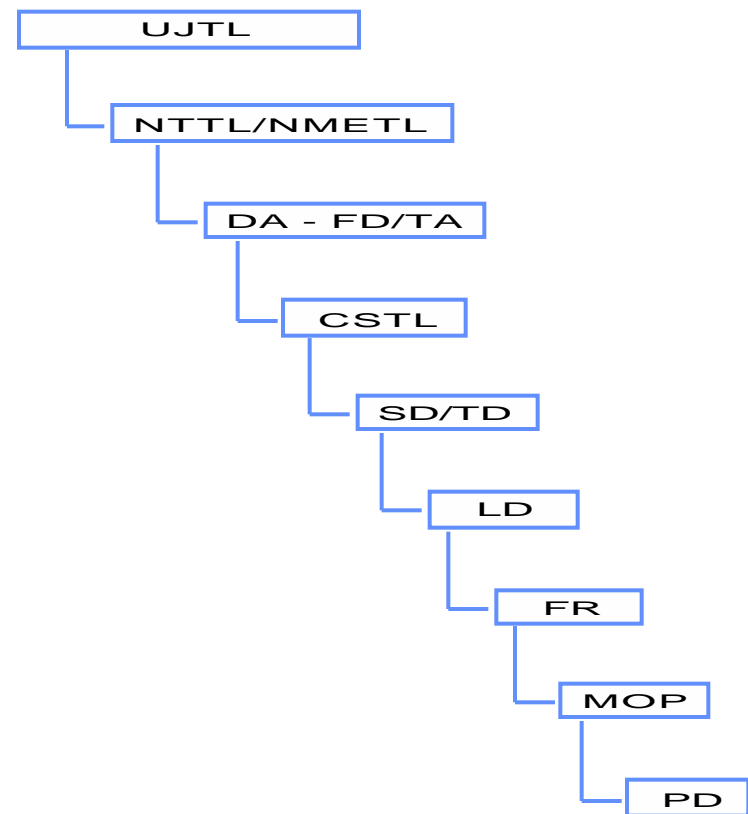
prepared for:

CNO N6M

# Navy
# Conceptual Models of the Mission Space (CMMS)

- From DMSO CMMS Vision:
  - Conceptual models of the mission space will provide simulation developers with a common starting point for constructing consistent and authoritative M&S representations.
  - The primary purpose of the CMMS is to facilitate interoperability and reuse of simulation components, particularly among DoD simulation developments.

  - You may view or download a copy of this brief from the Navy FPT web site:
    - http://www.bmh.com/FPT/fptframes.html

# TRACEABILITY

- Universal Joint Task List

- Naval Tactical Task List/Naval
  Mission Essential Task List

- Domain Analysis - Functional
  Decomposition/Task Assessment

- Collective Systems and Tasks List

- System Description/Task Description

- Logical Depiction

- Functional Requirements

- Measures of Performance

- Preliminary Design

```
UJTL
   └── NTTL/NMETL
          └── DA - FD/TA
                 └── CSTL
                        └── SD/TD
                               └── LD
                                      └── FR
                                             └── MOP
                                                    └── PD
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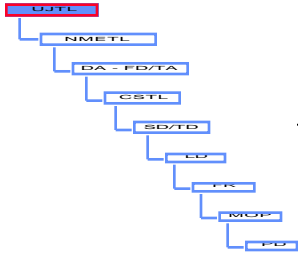
# Example

- Provide "linkage" of the CIWS system on the DDG-72 class ship
- Provide "linkage" of the IFF system on the DDG-72 class ship (demonstrate multiple paths)
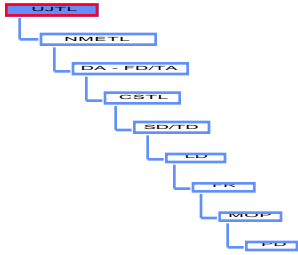
# Universal Joint Task List v2.1
## (Strategic National)

- SN 1  Conduct Strategic Deployment and Redeployment
- SN 2  Develop Strategic Intelligence
- SN 3  Employ Forces
- SN 4 Provide Sustainment
- SN 5 Provide Strategic Direction and Integration
- SN 6 Conduct Mobilization
- SN 7 Conduct Force Development

# Universal Joint Task List v2.1
## (Strategic Theater)

- ST 1 Conduct Intratheater Strategic Deployment, Concentration, and Maneuver of Forces
- ST 2 Develop Theater Strategic Intelligence
- ST 3 Employ Theater Strategic Firepower
- ST 4 Sustain Theater Forces
- ST 5 Provide Theater Strategic Command and Control
- ST 6 Provide Theater Protection
- ST 7 Establish Theater Force Requirements and Readiness
- ST 8 Develop and Maintain Alliance and Regional Relations
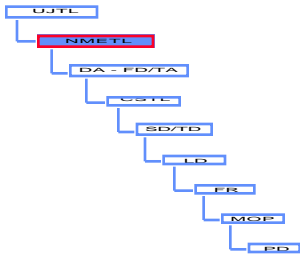
# Universal Joint Task List v2.1
## (Operational)

- OP 1 Conduct Operational Movement and Maneuver
- OP 2 Develop Operational Intelligence
- OP 3 Employ Operational Firepower
- OP 4 Provide Operational Support
- OP 5 Exercise Operational Command and Control
- OP 6 Provide Operational Protection
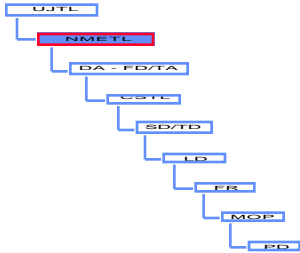
# Navy Tactical Task List v1.1
## (DRAFT)

- NTA 1 Conduct Maneuver
- NTA 2 Develop Intelligence
- NTA 3 Employ Firepower
- NTA 4 Perform Logistics and Combat Service Support
- NTA 5 Exercise Command and Control
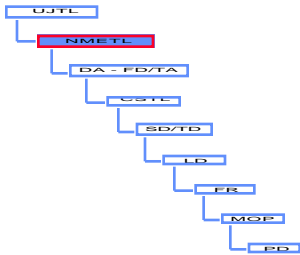- NTA 6 Provide Mobility and Survivability

# NTA 3  EMPLOY FIREPOWER

- To apply fires against air, ground, and sea targets by all available means and systems at tactical depths and operational/theater targets if assigned by higher authority. This task includes collective and coordinated use of target acquisition data, direct and indirect fire weapons, armed aircraft of all types, and other lethal and nonlethal means against air, ground, and sea targets. It includes strike missions tasked by higher authority throughout the theater, air interdiction, air warfare, surface warfare, undersea warfare, close air support, naval surface fire support, and  land based fire support .  Fires include all types of ordnance and electronic warfare (EW).

- **(JP 1, 3-0, 3-01.2, 3-01.4, 3-02.1, 3-03, 3-05, 3-09 Series, 3-10, 3-13, 3-51, 3-52, 5-00.2, NDP 1)**

# NTA 3  EMPLOY FIREPOWER

- NTA 3.1  PROCESS TARGETS
- NTA 3.2  ATTACK TARGETS
- NTA 3.3  INTEGRATE TACTICAL FIRES
- NTA 3.4  ORGANIZE FIRE SUPPORT ASSETS
- NTA 3.5  CONDUCT COORDINATED SPECIAL WEAPONS ATTACK

# NTA 3.2  ATTACK TARGETS

- NTA 3.2.1  ATTACK ENEMY LAND/MARITIME TARGETS
- NTA 3.2.2  ATTACK ENEMY AIRCRAFT AND MISSILES (OFFENSIVE COUNTER AIR)
- NTA 3.2.3  SUPPRESS ENEMY AIR DEFENSES (SEAD)
- NTA 3.2.4  CONDUCT ELECTRONIC ATTACK
- NTA 3.2.5  INTERDICT ENEMY OPERATIONAL FORCES/ TARGETS

- NTA 3.2.6  INTERCEPT, ENGAGE, AND NEUTRALIZE ENEMY AIRCRAFT AND MISSILE TARGETS (DEFENSIVE COUNTER AIR)
- NTA 3.2.7  CONDUCT FIRE SUPPORT
- NTA 3.2.8  CONDUCT NONLETHAL ENGAGEMENT
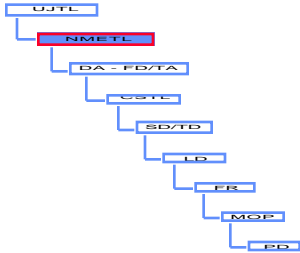
UJTL
NMETL
DA - FD/TA
CSTC
SD/TD
LD
FR
MOP
PD

# NTA 3.2.6 INTERCEPT, ENGAGE, AND NEUTRALIZE ENEMY AIRCRAFT AND MISSILE TARGETS (DEFENSIVE COUNTER AIR)

- To intercept, engage, neutralize, or destroy enemy aircraft and missiles in flight. Includes disruption of the enemy's theater missile (ballistic missiles, air-to-surface missiles, and air-, land-, and sea-launched cruise missiles) operations through an appropriate mix of mutually supportive passive missile defense, active missile defense, attack operations, and supporting C3I measures.

- (JP 3–01.5)
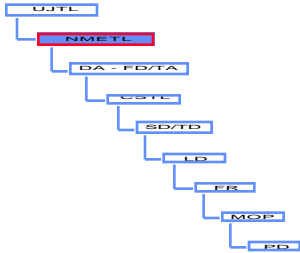
# NTA 3.2.6  INTERCEPT, ENGAGE, AND NEUTRALIZE ENEMY AIRCRAFT AND MISSILE TARGETS (DEFENSIVE COUNTER AIR)

- NTA 3.2.6.1  EMPLOY AIR-TO-AIR WEAPONS
- NTA 3.2.6.2  EMPLOY SURFACE-TO-AIR WEAPONS
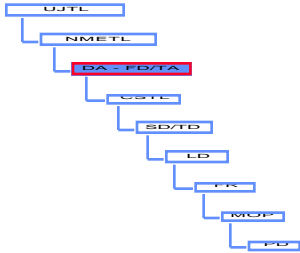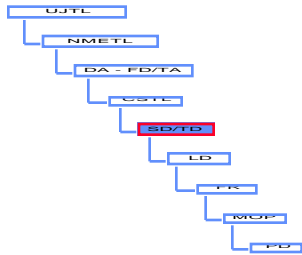
# NTA 3.2.6.2 EMPLOY SURFACE-TO-AIR WEAPONS

- Domain Analysis / Functional Decomposition / Task Analysis results:
  - Air Defense Warfare (ADWC)

- CG-65
- DDG-72
- DD-968
- CVN-68
- AOE
- AFS

- LHA
- LPD
- LSD

# Collective Systems & Tasks List (CSTL)

UJTL
NMETL
DA – FD/TA
CSTL
SD/TD
LD
FR
MOP
PD

- 1.0 SYSTEMS

- 2.0 TASKS

# System Description/ Task Description (SD/TD)

If System:

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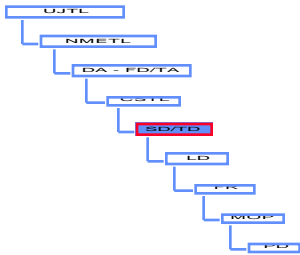
- 1.0 SYSTEMS

</div>
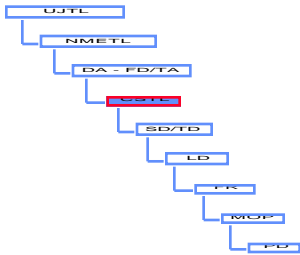
If Behavior

- 2.0 TASKS

# 1.0 Systems (CSTL)
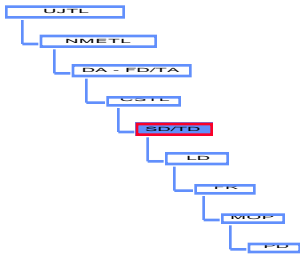
- 1.1 Engineering
- 1.2 Operations
- **1.3 Combat Systems**
- 1.4 Logistics

# 1.0 Systems (SD)

- 1.1  Engineering.
- 1.2  Operations.
- **1.3  Combat Systems.**
- 1.4  Logistics.

# 1.3 Combat Systems (CSTL)

- **1.3.1 CIWS**
- 1.3.2 5" Naval Gun
- 1.3.3 Harpoon
- 1.3.4 Tomahawk
- 1.3.5 Aegis Weapon System
- 1.3.6 NATO Sea Sparrow (N/A)

- 1.3.7 Rolling Airframe Missile (N/A)
- 1.3.8 SQQ-89 IUSS
- 1.3.9 Machine Guns (N/A)
- 1.3.10 Stinger (N/A)
- 1.3.11 Countermeasures

# 1.3  Combat Systems (SD)

- 1.3.1  CIWS.

- 1.3.2  5 inch Naval Gun.

- 1.3.3  Harpoon.

- 1.3.4  Tomahawk.

- 1.3.5  Aegis Weapon System.

- 1.3.6  NATO Sea Sparrow.

- 1.3.7  Rolling Airframe Missile.

- 1.3.8  SQQ-89 IUSS.

- 1.3.9  Machine Guns.

- 1.3.10  Stinger.

- 1.3.11  Countermeasures.

# 1.3.1 CIWS (SD).

- Additional information on the Close-in Weapon System (CIWS) can be found in the CIWS System Description dated 13 March, 1996. The following information is data that pertains exclusively to CIWS installed on DDG 72.

- (Additional data is classified and was removed to facilitate inclusion on the web.)
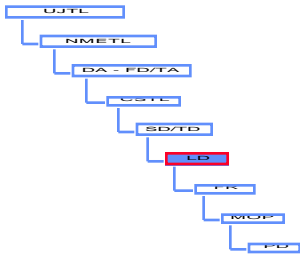
This figure is classified and was removed to facilitate inclusion on the web.

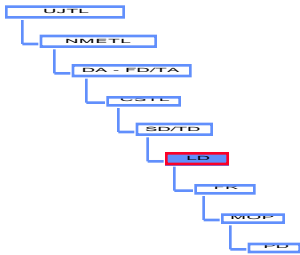- Figure 9 - (U) CIWS Firing Zones
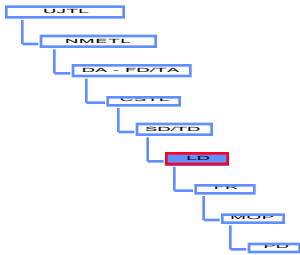
# CIWS Logical Depiction (LD)
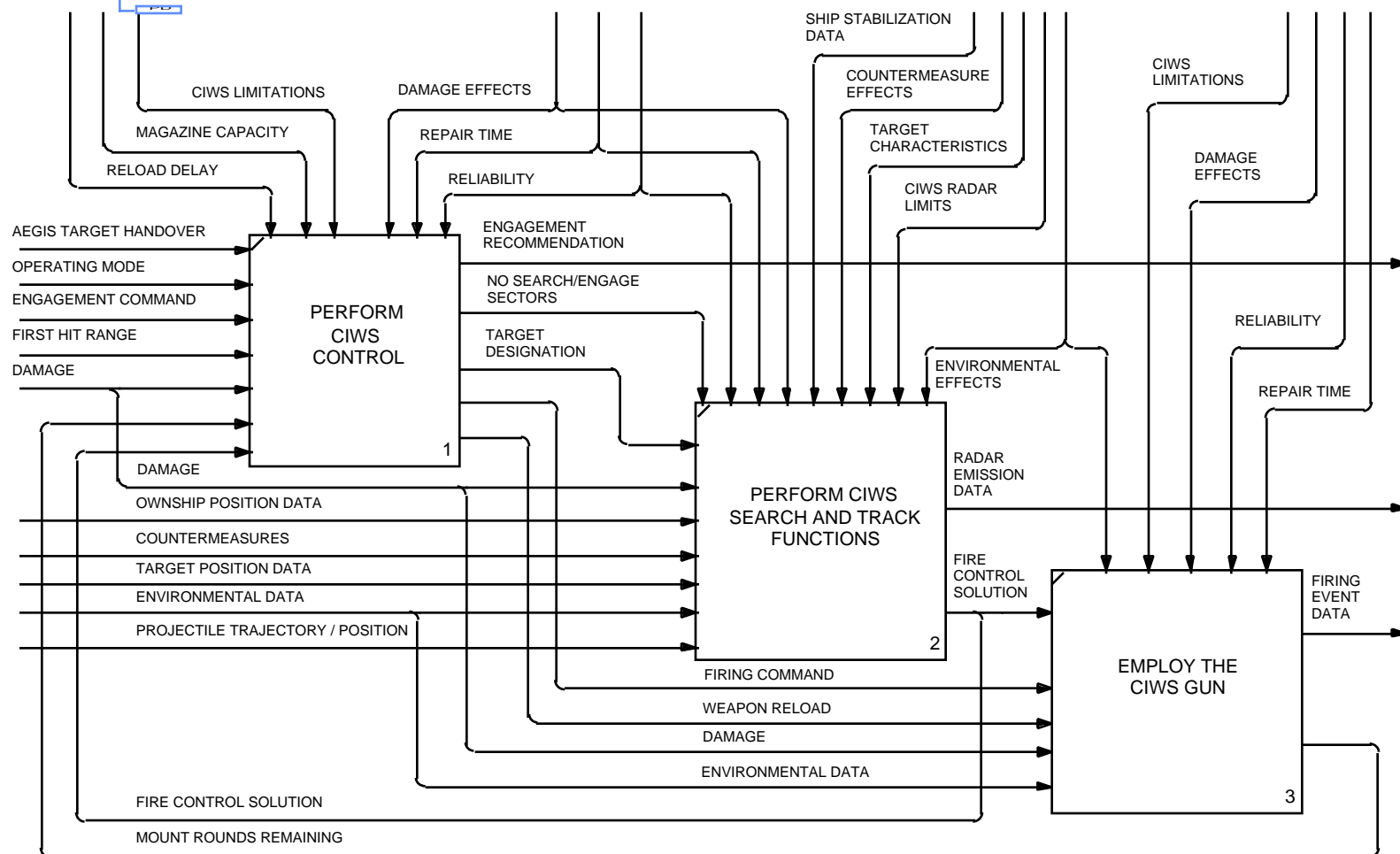
# IDEF0
# Inputs, Controls, Outputs

- Perform CIWS Control

- Perform CIWS Search and Track Functions

- Employ the CIWS Gun

# Employ the CIWS Gun

## Inputs:

- 1.    Fire Control Solution.
  - A ballistic gun solution which considers CIWS capabilities, limitations and constraints.  It is required in order for an engagement to occur and provides aiming requirements for the CIWS gun.

- 2.    Firing Command.
  - A command to the CIWS gun to shoot at a target for which a fire control solution exists.

- 3.    Weapon Reload.
  - An indication to the CIWS gun that a reload of the mount is complete.

- 4.    Damage.
  - Damage to the ship or Close-In Weapon System gun which affects its ability to engage an airborne target.

- 5.    Environmental Data.
  - Conditions which include, but are not limited to, sea state and inclement weather ducting that might affect CIWS gun performance.
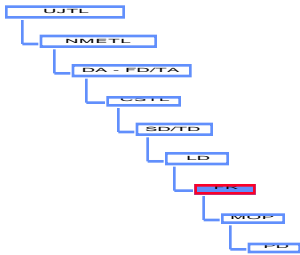
# Employ the CIWS Gun Controls:

- 1.    Environmental Effects.
  - The amount or extent that sea state and other factors affect the CIWS gun's ability to engage targets.

- 2.    CIWS Limitations.
  - Operating constraints of the CIWS gun including firing and slew rates as well as firing cutouts which provide physical / electrical limitations which prevent the CIWS from shooting into the ship's superstructure.

- 3.    Damage Effects.
  - The effect of damage to the CIWS gun that affects the ship's ability to engage a threat.

- 4.    Reliability.
  - Mean time between failure data for the CIWS gun and its supporting hardware.

- 5.    Repair Time.
  - Based upon damage effects or hardware failure, the expected time to repair the damage and restore the CIWS gun to an operational status.

# Employ the CIWS Gun Outputs:

- 1.   Firing Event Data.
  - Firing event data includes information such as initial projectile velocity vector, projectile type, trajectory, and time of flight information which describe engagement projectile dynamics.

- 2.   Mount Rounds Remaining.
  - The number of rounds remaining for use by each CIWS mount.

# 2. Functional Requirements.

- Perform CIWS Control
- Perform CIWS Search and Track Functions
- Employ the CIWS Gun

# Employ the CIWS Gun
# Functional Requirements (FR)

- 1.      The CIWS gun shall engage targets, at the prescribed rate of fire, as a result of a firing command.

- 2.      Engagements shall cease when the target has been destroyed, the target enters a cutout arc region, or when the engagement envelope parameters are no longer met.

- 3.      Firing Event Data shall include the initial projectile velocity vector, projectile type, number of rounds, burst duration, and other information required to describe a CIWS engagement.

- 4.      The number of rounds remaining shall be appropriately decremented and reported following each engagement.

- 5.      The CIWS gun shall be incapable of firing if available mount rounds are depleted.

- 6.      The ability to employ the CIWS gun shall be appropriately impacted as a result of damage effects or material failure.

- 7.      The ability to employ CIWS shall be appropriately impacted as a result of environmental effects.

# Employ the CIWS Gun
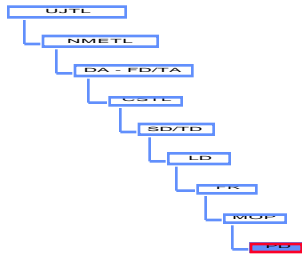# Measures of Performance (MOP)

- 1.      Verify the CIWS gun's ability to engage targets, at the prescribed rate of fire, as a result of a firing command.

- 2.      The capability to terminate engagements when the target has been destroyed, the target enters a cutout arc region, or when the engagement envelope parameters are no longer met shall be verifiable.

- 3.      Verify that firing event data includes the initial projectile velocity vector, projectile type, number of rounds, burst duration, and other information required to describe a CIWS engagement.

- 4.      Ensure that the number of rounds remaining are appropriately decremented and reported following each engagement.

- 5.      Verify that the CIWS gun is incapable of firing when available mount rounds are depleted.

- 6.      Ensure that the ability to employ the CIWS gun is appropriately impacted as a result of damage effects or material failure.

- 7.      Verify that the ability to employ CIWS is appropriately impacted as a result of environmental effects.
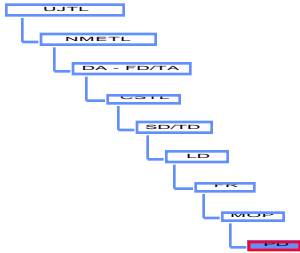
# CIWS Preliminary Design
## Combat Systems - Gun - CIWS

- 1. Firing Event Data.
  - Firing event data will include all information required to compute projectile ballistic flyouts including initial projectile velocity vector, projectile type, trajectory, time of flight, and the location in space for any detonations.

- 2. Radar Emissions.
  - The CIWS radar emission data will be modeled for the purpose of informing other entities that the CIWS radar is operational. The CIWS radar model will not include effects upon the system due to countermeasures.

- 3. Magazine Management.
  - The quantity of projectiles remaining shall be appropriately decremented from the magazine throughout each firing event. When the magazine is empty, the gun will not fire.
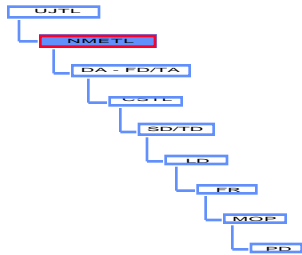
- 4. Engagement Criteria.

  – The CIWS engagement criteria will determine if CIWS is capable of engaging a target. The CIWS engagement criteria will consider if the target has a low target angle, a low altitude and a sufficient closing velocity. Only the automatic and off modes will be modeled. To determine the point at which the CIWS will engage the target when in automatic mode, the CIWS will calculate the point using the closing velocity of the target, the engagement envelope, the time of flight of the rounds, the burst duration, and the burst number of rounds. In off mode, the CIWS will not automatically engage the target. The engagement shall cease when the target enters a cutout arc region, or when the engagement criteria are no longer met.

- 5. Engagement Criteria.

  – The performance characteristics of "closed-loop" radar tracking for CIWS will be modeled. Tracking of CIWS projectiles will not be modeled.

- 6. Operation Limitations.

  – The Automatic and Off modes will be selectable. The CIWS will not fire at targets in the weapons cut-out arcs or in the weapons no-engage sectors.
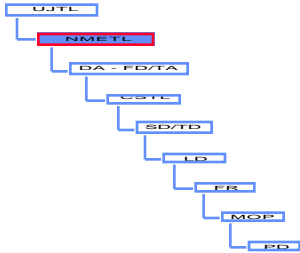
# CIWS Preliminary Design
## Combat Systems - Gun - CIWS

- 7. Search Radar Limits.
  - The CIWS radar search/track capability limits will be modeled as part of the engagement criteria.

- 8. Delay Times.
  - Reaction time delays and delays between engagements of different targets will be modeled. During reloading of the CIWS magazine, the CIWS will not be capable of firing.

- 9. Gun Failure.
  - The ability to employ the CIWS shall be appropriately impacted as a result of casualty due to damage. The operator will be able to impose damage and conduct damage repair prior to and at any time throughout the exercise. Material failure due to anything other than battle damage will not be modeled.

- 10. Environmental Effects.
  - Effects on the CIWS due to environmental effects such as pitch and roll will not be modeled.
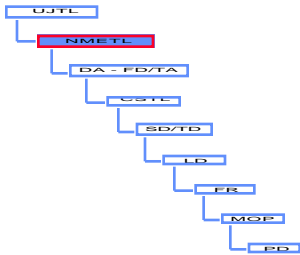
# NTA 3  EMPLOY FIREPOWER

- To apply fires against air, ground, and sea targets by all available means and systems at tactical depths and operational/theater targets if assigned by higher authority. This task includes collective and coordinated use of target acquisition data, direct and indirect fire weapons, armed aircraft of all types, and other lethal and nonlethal means against air, ground, and sea targets. It includes strike missions tasked by higher authority throughout the theater, air interdiction, air warfare, surface warfare, undersea warfare, close air support, naval surface fire support, and  land based fire support .  Fires include all types of ordnance and electronic warfare (EW).

- **(JP 1, 3-0, 3-01.2, 3-01.4, 3-02.1, 3-03, 3-05, 3-09 Series, 3-10, 3-13, 3-51, 3-52, 5-00.2, NDP 1)**

# NTA 3  EMPLOY FIREPOWER

- NTA 3.1  PROCESS TARGETS

- NTA 3.2  ATTACK TARGETS

- NTA 3.3  INTEGRATE TACTICAL FIRES

- NTA 3.4  ORGANIZE FIRE SUPPORT ASSETS

- NTA 3.5  CONDUCT COORDINATED SPECIAL WEAPONS ATTACK

# NTA 3.1 Process Targets

- NTA 3.1.1 REQUEST ATTACK
- **NTA 3.1.2 SELECT TARGET TO ATTACK**
- NTA 3.1.3 SELECT SYSTEM FOR ATTACK
- NTA 3.1.4 DEVELOP ORDER TO FIRE
- NTA 3.1.5 CONDUCT TACTICAL COMBAT ASSESSMENT
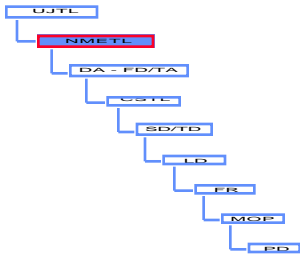
# NTA 3.1.2 SELECT TARGET TO ATTACK

- To analyze each target to determine if and when it should be attacked. This task includes: define target selection criteria; reviewing the rules of engagement and the laws of armed conflict, compare sensor data to target selection criteria; perform target duplication checks; issue warning orders, determine target location, determine moving target intercept points; fuse target build-up reports to create a list of targets and/or target list; perform target list maintenance; and choose targets. (JP 2-0, 2-01.1, 3-0, 3-01.4, 3-02, 3-02.1, 3-03, 3-05, 3-05.5, 3-07.2, 3-09 Series, 3-12, 3-53, 3-55, 3-56.1, 3-58, 5-00.2)
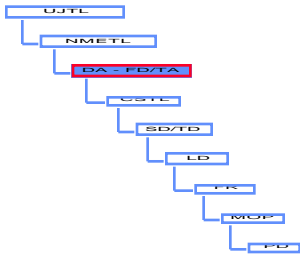
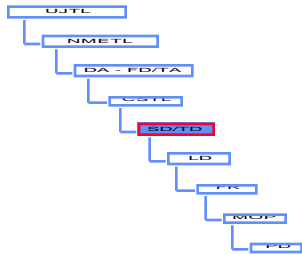# NTA 3.1.2 SELECT TARGET TO ATTACK

- Domain Analysis / Functional Decomposition / Task Analysis results:

    – All "friendly" entities will be IFF capable

    – IFF will be a means of target selection

# Collective Systems & Tasks List (CSTL)

- 1.0 SYSTEMS

- 2.0 TASKS

# System Description/ Task Description (SD/TD)

If System:

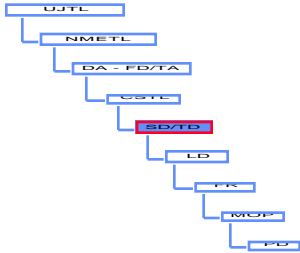- 1.0 SYSTEMS

If Behavior

- 2.0 TASKS

# 1.0 Systems (CSTL)

- 1.1 Engineering
- 1.2 Operations
- 1.3 Combat Systems
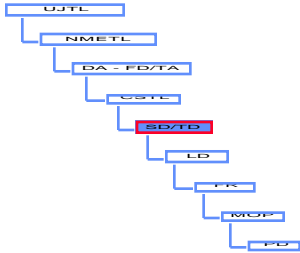- 1.4 Logistics

# 1.0 Systems (SD)

- 1.1  Engineering.

- **1.2  Operations.**

- 1.3  Combat Systems.

- 1.4  Logistics.

# 1.2 Operations (CSTL)

- 1.2.1 Communications
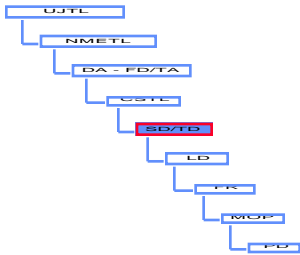- 1.2.2 Navigation
- 1.2.3 IFF

# 1.2 Operations (SD)

- 1.2.1 Communications.
- 1.2.2 Navigation.
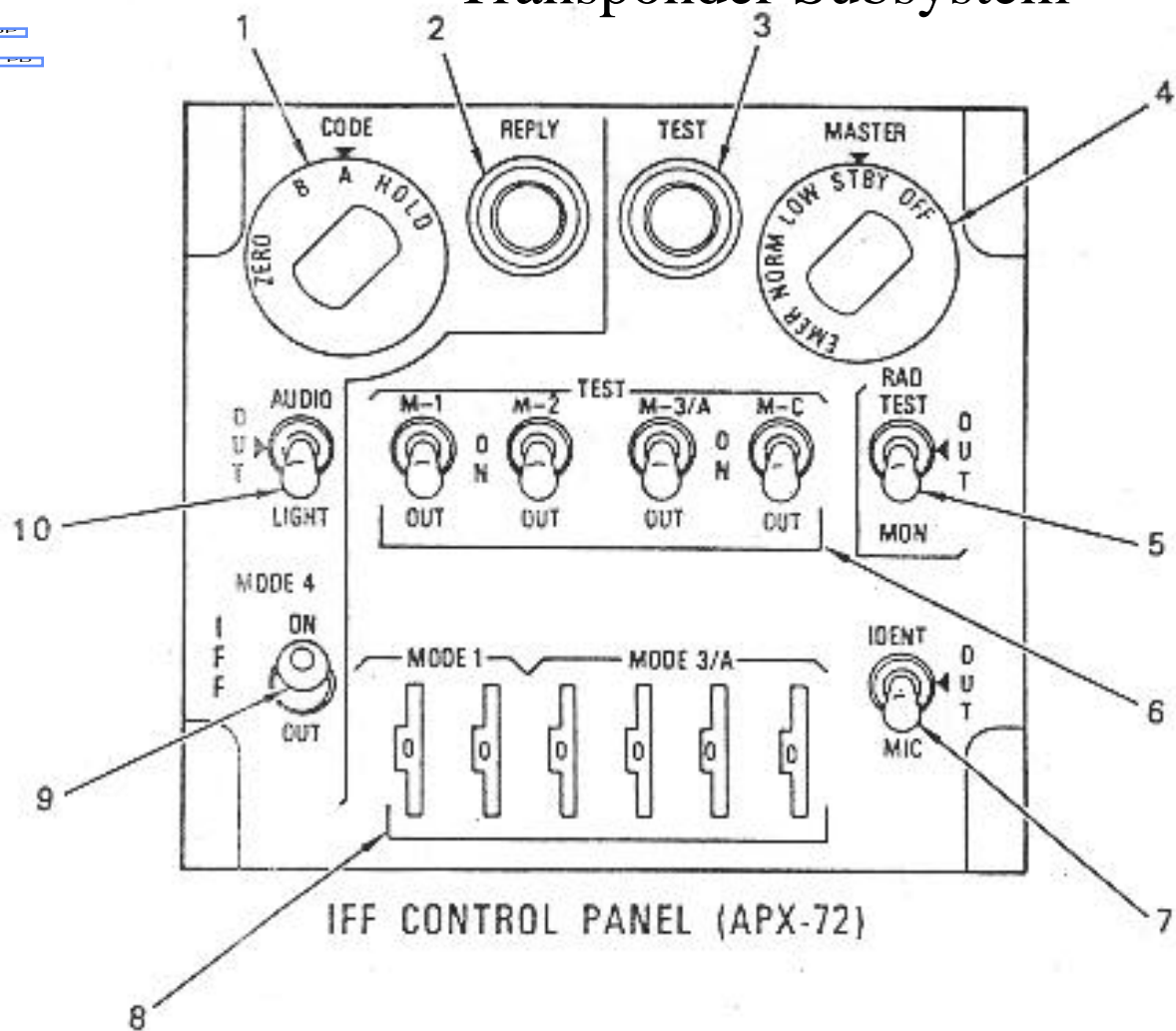- 1.2.3 IFF.

# 1.2.3 IFF (CSTL)

- 1.2.3.1 AIMS Mk XII

# 1.2.3 IFF (SD)

- Overview:  The AIMS Mk XII Identification Friend or Foe (IFF) system electronically distinguishes ships and aircraft by performing two distinct functions:  the transponder subsystem provides own ship or aircraft data in response to interrogations by other platforms and the interrogation subsystem challenges surface and airborne units to gather IFF data for onboard use.  While not all U.S. military ships and aircraft will have interrogators, most will be equipped with transponders to reply to interrogations.  Like radar, IFF interrogation is limited by numerous factors (capability of the radar, radar antenna height above sea level, interrogated unit altitude, etc., and a wide variety of atmospheric and geographic conditions). ... more...
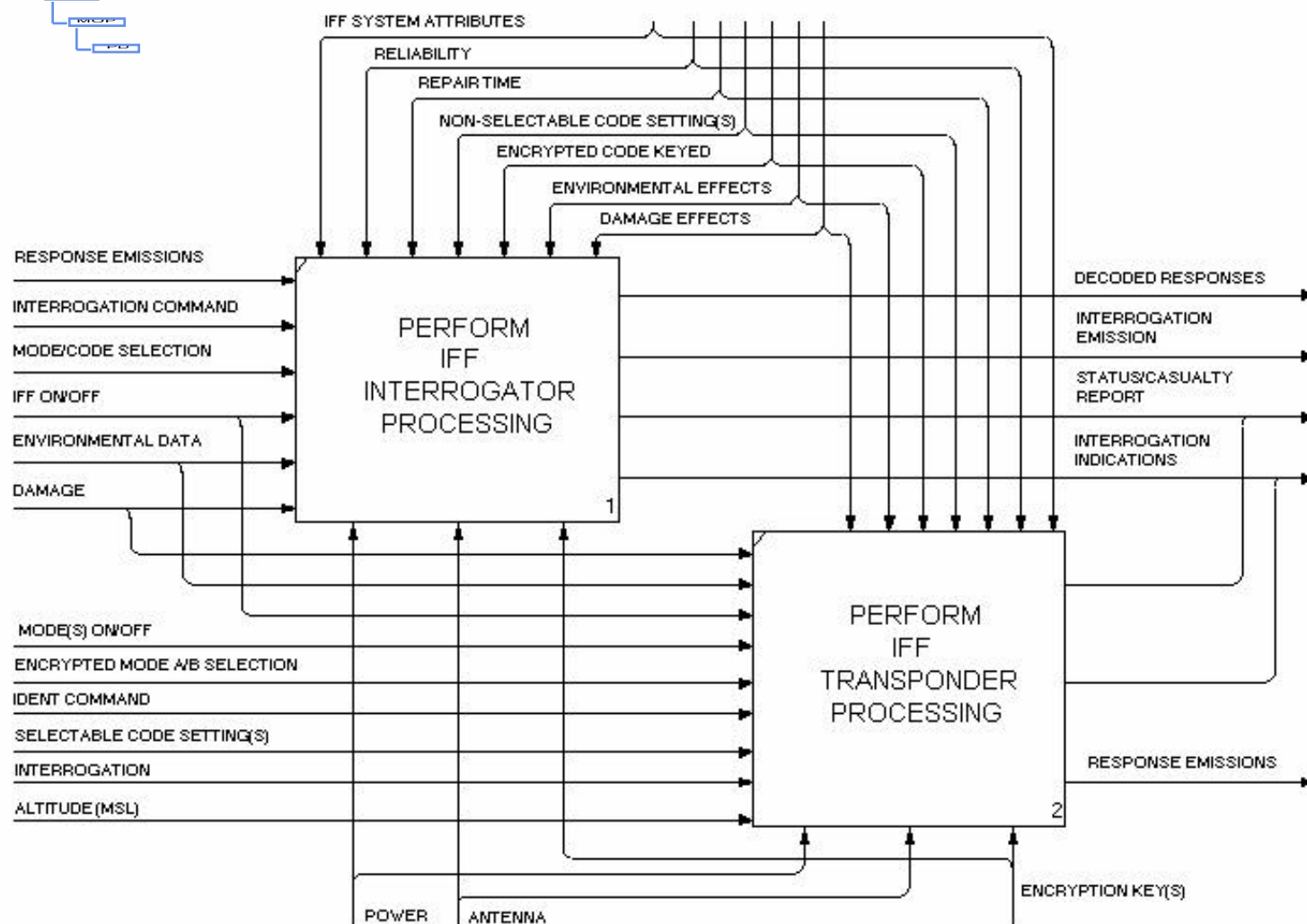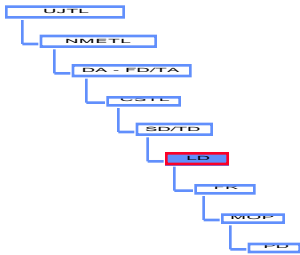
# 1.2.3 IFF (SD)
## Transponder Subsystem



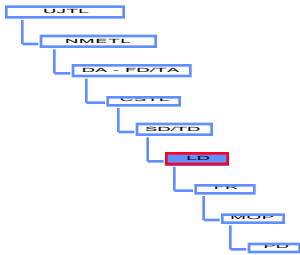IFF CONTROL PANEL (APX-72)

# IFF Logical Depiction (LD)

# IDEF0
# Inputs, Controls, Outputs

- Perform IFF Interrogator Processing
- Perform IFF Transponder Processing

# Perform IFF Transponder Processing

Inputs:

- 1. Damage.
  - Damage to the IFF transponder which may affect its performance.

- 2. Environmental Data.
  - Environmental conditions which may affect IFF transponder performance.

- 3. IFF On/Off.
  - Master power control switch to the IFF System.

- 4. Mode(s) On/Off.
  - Individual power control switches to each operational IFF mode (i.e., 1, 2, 3/A, 4, & C).

- 5. Encrypted Mode A/B Selection.
  - Manually selected encrypted Mode position that is selected at a designated daily time and/or prior to a mission.

- 6. IDENT Command.
  - Crew generated action in response to a voice communication requesting an IDENT. Crew commands the transponder to IDENT.

- 7. Selectable Code Setting(s).
  - Code(s) selected manually by system operators via thumbwheel selectors (i.e., Mode 1 and 3).

- 8. Interrogation.
  - External interrogation inquiries from surface or airborne stations that the IFF transponder will respond to with coded identification (all) and altitude signals (aircraft only).

- 9. Altitude (MSL).
  - Actual aircraft altitude (relative to mean sea level) information that is transmitted via Mode C transmissions in response to a ground station's interrogation. Most often used for air traffic control altitude deconfliction.

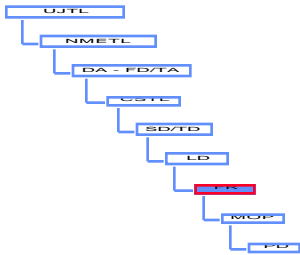# Perform IFF Transponder Processing Controls:

- 1. Damage Effects.
  - The amount or extent that damage to the IFF transponder will affect its ability to receive, or respond to, interrogations.

- 2. Environmental Effects.
  - The amount or extent that the environment affects IFF transponder performance (these include weather, sea state, etc.).

- 3. Encrypted Code Keyed.
  - Encrypted code (i.e., Mode 4) set. In some instances, the code for the current day is set in position A and the code for the next day is set in position B. This is necessary to permit units which are incapable of "re-keying" to operate in missions which begin one day and end the next.

- 4. Non-Selectable Code Setting(s).
  - Specific, non-selectable platform identification code(s) set prior to the mission (i.e., Mode 2).

- 5. Repair Time.
  - Based upon damage effects or hardware failure, the expected time to repair the damage and restore the transponder to an operational status.

- 6. Reliability.
  - Mean time between failure data for the IFF transponder and its supporting hardware.

- 7. IFF System Attributes.
  - Characteristics of the IFF System, such as operating frequency, mode/code descriptions, interrogation ranges (per mode) and update periodicity.

# Perform IFF Transponder Processing

## Outputs:

- 1. Status / Casualty Report.
  - A report that indicates that the transponder is operational, or has suffered damage or equipment failure.

- 2. Interrogation Indications.
  - Internal ship or aircraft lights and displays to indicate interrogations are being received.

- 3. Response Emission.
  - These emmissions can be:
    - a. Automatic coded identification and altitude signals in response to interrogations from surface or airborne stations, or.
    - b. An Identification of Position (IDENT) reply selected manually by aircrew (switch is spring-loaded return).  IDENT responses provide identification of position to Mode 1, 2, and 3/A for 20-25 seconds.

# 2. Functional Requirements.

- Perform IFF Interrogator Processing
- Perform IFF Transponder Processing

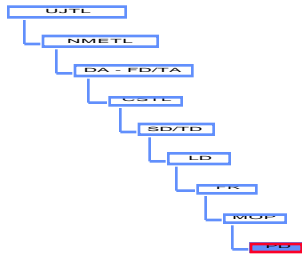# Perform IFF Transponder Processing Functional Requirements (FRs)

- 1. The capability to power the IFF System as well as specific individual modes shall be provided.

- 2. The IFF transponder shall be capable of responding to proper external interrogation inquiries from surface or airborne stations with correctly coded identification and altitude responses.

- 3. The system shall have the capability to transmit an IDENT reply.

- 4. The ability to receive and respond to interrogations shall be appropriately impacted as a result of inactive modes, damage, reliability, and/or environmental effects.

- 5. The requirement to respond to an interrogation shall consider the sensitivity attributes of the transponder and the distance between the interrogation platform and the responding platform.

- 6. Appropriate indications that interrogation challenges have been received shall be provided.

# Perform IFF Transponder Processing Measures of Performance (MOPs)

- 1. The capability to power the IFF System as well as the specific individual modes shall be verifiable.

- 2. The effect of manual and mechanical mode settings and keys on the IFF System's ability to receive and respond to interrogations shall be verified.

- 3. The ability to transmit an IDENT reply in response to a controller's verbal request shall be verifiable.

- 4. The impact of inactive modes, reliability, damage, and/or environmental

- effects on the system's ability to receive and respond to interrogations shall be verified.

- 5. The effects of transponder response as a function of sensitivity as it relates to the distance between the interrogation platform and the responding platform shall be verifiable.

- 6. Appropriate indications of interrogation challenges shall be verified.
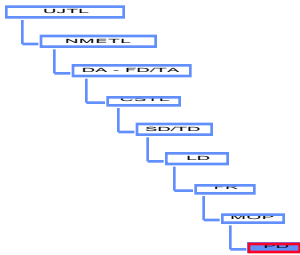
# IFF Preliminary Design

- The Preliminary Design for the Identification Friend or Foe (IFF) system provides a high level approach to implementation of the IFF system. Desired IFF model performance characteristics identified from an analysis of the IFF Logical Depiction resulted in several Functional Requirements (which were listed in order of relative importance). Subsequently, Measures of Performance were then identified to verify the IFF System model. The following design criteria are established to specifically address and restate (in the same order of relative importance) the Functional Requirements and Measures of Performance identified in the IFF System model Logical Depiction.

# IFF Preliminary Design

- Perform IFF Interrogator Processing

- **Perform IFF Transponder Processing**

# IFF Preliminary Design

- 1.  The capability to power the IFF System as well as specific individual modes shall be provided.
    - a.  The capability to turn the IFF transponder on and off shall be provided.  If the IFF system is off, no code values shall be reported.
    - b.  The capability to turn each mode of the IFF system (i.e., 1, 2, 3/A, C, 4) on and off shall be provided.  If a mode is turned off, no code values shall be reported for that mode.

# IFF Preliminary Design

- 2. The IFF transponder shall be capable of responding to proper external interrogation inquiries from surface or airborne stations with correctly coded identification and altitude responses.
  - a. The capability to enter and report specific codes for the all applicable modes shall be provided. For example, the following would apply to BLUFOR:

    | Mode | 1st Digit | 2nd Digit | 3rd Digit | 4th Digit |
    |------|-----------|-----------|-----------|-----------|
    | 1 | 0 - 7 | 0 - 3 | N/A | N/A |
    | 2 | 0 - 7 | 0 - 7 | 0 - 7 | 0 - 7 |
    | 3/A | 0 - 7 | 0 - 7 | 0 - 7 | 0 - 7 |
    | 4* | | | | |

    - * Implementation non-specific with functionality to report No response / invalid response; valid blue response; and, valid non-blue response.
    - A similar mode/code description should be implemented for REDFOR or other types of IFF systems.
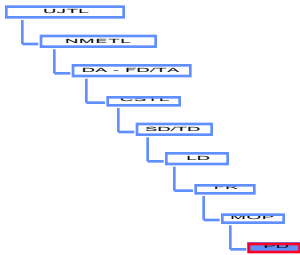  - b. The capability to determine and report altitudes, if applicable, shall be provided. For example, the following would apply to BLUEFOR:

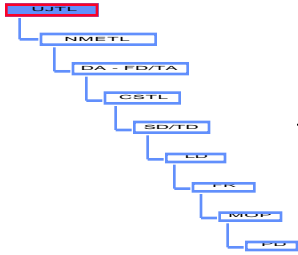    | Mode | Response |
    |------|----------|
    | C | -1,000 to 127,000 Ft. MSL in 100 foot increments |

# IFF Preliminary Design

- 3. The system shall have the capability to transmit an IDENT reply in response to a controller's verbal request.

  - a. An IDENT reply shall be generated for each IDENT command.

- 4. The ability to receive and respond to interrogations shall be appropriately impacted as a result of inactive modes, damage, reliability, and/or environmental effects.

  - a. Response to interrogations shall be inhibited for transponder modes that have been rendered inactive.

  - b. The capability to turn a functioning IFF transponder off as a result of damage or material failure shall not be provided.

  - c. Functionality regarding the effects of environment shall not be provided.
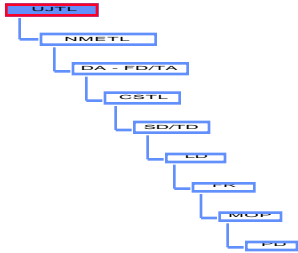
# IFF Preliminary Design

- 5.  The requirement to respond to an interrogation shall consider the sensitivity attributes of the transponder and the distance between the interrogation platform and the responding platform.
    - a.  The capability for the transponder platform to consider the sensitivity attributes of the transponder and the distance between the interrogation platform and the responding platform to determine whether a response should be sent shall not be provided.

- 6.  Appropriate indications that interrogation challenges have been received shall be accurately modeled.
    - a.  Functionality regarding the indication of interrogations being received by the transponder shall not be provided.

# Universal Joint Task List v2.1
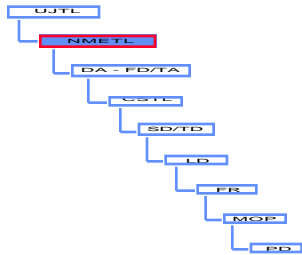## (Strategic Theater)

- ST 1 Conduct Intratheater Strategic Deployment, Concentration, and Maneuver of Forces
- ST 2 Develop Theater Strategic Intelligence
- ST 3 Employ Theater Strategic Firepower
- ST 4 Sustain Theater Forces
- ST 5 Provide Theater Strategic Command and Control
- ST 6 Provide Theater Protection
- ST 7 Establish Theater Force Requirements and Readiness
- ST 8 Develop and Maintain Alliance and Regional Relations

# Universal Joint Task List v2.1
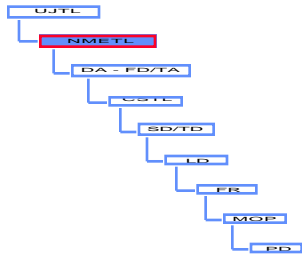## (Operational)

- OP 1 Conduct Operational Movement and Maneuver

- OP 2 Develop Operational Intelligence

- OP 3 Employ Operational Firepower

- OP 4 Provide Operational Support

- OP 5 Exercise Operational Command and Control

- OP 6 Provide Operational Protection

# Navy Tactical Task List v1.1
## (DRAFT)

- NTA 1 Conduct Maneuver
- NTA 2 Develop Intelligence
- NTA 3 Employ Firepower
- NTA 4 Perform Logistics and Combat Service Support
- NTA 5 Exercise Command and Control
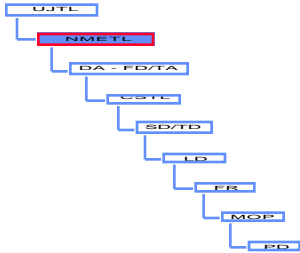- NTA 6 Provide Mobility and Survivability

# NTA 6 PROVIDE MOBILITY AND SURVIVABILITY

- To provide the ability of the force to move freely relative to the enemy and execute its mission. This task includes those survivability measures the force takes to remain viable and functional by protecting, avoiding or mitigating the effects of enemy weapon systems and natural occurrences. It also includes actions to counter the mobility of enemy or other forces such as mining, maritime interdiction, blockade, and to counter drug and other contraband smuggling.

- JP 0-2, 3-01.2, 3-01.4, 3-01.5, 3-02, 3-02.1, 3-05.5, 3-09.1, 3-09.2, 3-10.1, 3-11, 3-13, 3-18, 3-18.1, 3-51, 3-52, 3-55, FMFM 13
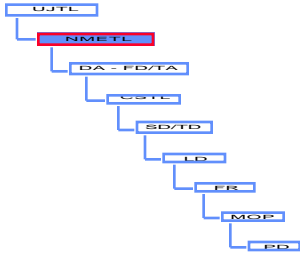
# NTA 6  PROVIDE MOBILITY AND SURVIVABILITY

- NTA 6.1  MAINTAIN MOBILITY
- NTA 6.2  CONDUCT COUNTERMOBILITY
- NTA 6.3  ENHANCE SURVIVABILITY
- NTA 6.4  RESCUE AND RECOVER
- NTA 6.5  PROVIDE SECURITY FOR OPERATIONAL FORCES AND MEANS
- NTA 6.6  PROVIDE DISASTER RELIEF

# NTA 6.3 ENHANCE SURVIVABILITY

- **NTA 6.3.1** PROTECT AGAINST COMBAT AREA HAZARDS

- NTA 6.3.2 EMPLOY OPERATIONS SECURITY

- NTA 6.3.3 CONDUCT DECEPTION IN SUPPORT OF TACTICAL OPERATIONS

- NTA 6.3.4 MAINTAIN COUNTERRECONNAISSANCE

- NTA 6.3.5 PERFORM ANTI/COUNTERTERRORISM
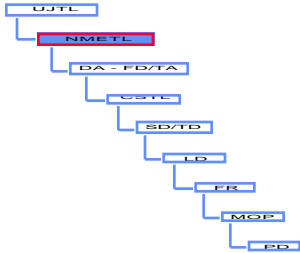
# NTA 6.3.1  PROTECT AGAINST COMBAT AREA HAZARDS

- NTA 6.3.1.1  PROTECT INDIVIDUALS AND SYSTEMS

- NTA 6.3.1.2  REMOVE BATTLESPACE HAZARDS

- NTA 6.3.1.3  POSITIVELY IDENTIFY FRIENDLY FORCES
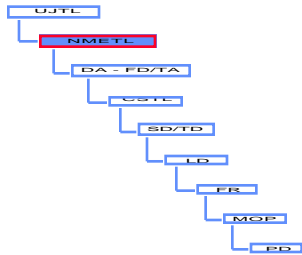
# NTA 6.3.1.3  POSITIVELY IDENTIFY FRIENDLY FORCES

- To provide the means, procedures, and equipment to positively identify friendly forces and distinguish them from unknown, neutral, or enemy forces. This task includes positively distinguishing friendly from enemy forces through various methods including visual, electronic and acoustic.
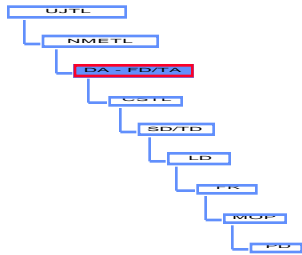
# NTA 6.3.1.3  POSITIVELY IDENTIFY FRIENDLY FORCES

- Domain Analysis / Functional Decomposition / Task Analysis results

  – All Naval Ships and Aircraft will have IFF capability

# Collective Systems
# & Tasks List (CSTL)

- 1.0 SYSTEMS

- 2.0 TASKS

# System Description/
# Task Description (SD/TD)

If System:

- 1.0 SYSTEMS

If Behavior

- 2.0 TASKS

# 1.0 Systems (CSTL)

- 1.1 Engineering
- 1.2 Operations
- 1.3 Combat Systems
- 1.4 Logistics

# 1.0 Systems (SD)

- 1.1  Engineering.
- **1.2  Operations.**
- 1.3  Combat Systems.
- 1.4  Logistics.

# 1.2 Operations (CSTL)

- 1.2.1 Communications
- 1.2.2 Navigation
- 1.2.3 IFF

# 1.2 Operations (SD)

- 1.2.1 Communications.
- 1.2.2 Navigation.
- 1.2.3 IFF.

# 1.2.3 IFF (CSTL)

- 1.2.3.1 AIMS Mk XII

# 1.2.3 IFF (SD)

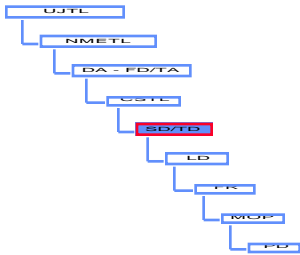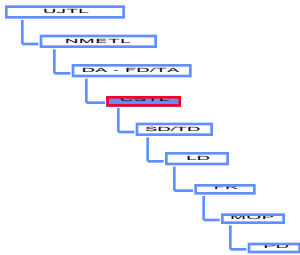- Overview:  The AIMS Mk XII Identification Friend or Foe (IFF) system electronically distinguishes ships and aircraft by performing two distinct functions:  the transponder subsystem provides own ship or aircraft data in response to interrogations by other platforms and the interrogation subsystem challenges surface and airborne units to gather IFF data for onboard use.  While not all U.S. military ships and aircraft will have interrogators, most will be equipped with transponders to reply to interrogations.  Like radar, IFF interrogation is limited by numerous factors (capability of the radar, radar antenna height above sea level, interrogated unit altitude, etc., and a wide variety of atmospheric and geographic conditions). ... more...

# 1.2.3 IFF (SD)
## Transponder Subsystem

UJTL
NMETL
DA – FD/TA
CSTC
SD/TD
LD
FR
MOP
PD



IFF CONTROL PANEL (APX-72)

# IFF Logical Depiction (LD)

UJTL
NMETL
DA – FD/TA
CSTC
SD/TD
LD
FR
MOP
PD

IFF SYSTEM ATTRIBUTES
RELIABILITY
REPAIR TIME
NON-SELECTABLE CODE SETTING(S)
ENCRYPTED CODE KEYED
ENVIRONMENTAL EFFECTS
DAMAGE EFFECTS

RESPONSE EMISSIONS
INTERROGATION COMMAND
MODE/CODE SELECTION
IFF ON/OFF
ENVIRONMENTAL DATA
DAMAGE

PERFORM
IFF
INTERROGATOR
PROCESSING
1

DECODED RESPONSES
INTERROGATION EMISSION
STATUS/CASUALTY REPORT
INTERROGATION INDICATIONS

MODE(S) ON/OFF
ENCRYPTED MODE A/B SELECTION
IDENT COMMAND
SELECTABLE CODE SETTING(S)
INTERROGATION
ALTITUDE (MSL)

PERFORM
IFF
TRANSPONDER
PROCESSING
2

RESPONSE EMISSIONS
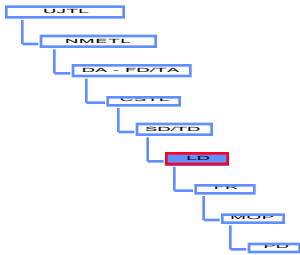
POWER    ANTENNA

ENCRYPTION KEY(S)

# IDEF0
# Inputs, Controls, Outputs

- Perform IFF Interrogator Processing
- Perform IFF Transponder Processing
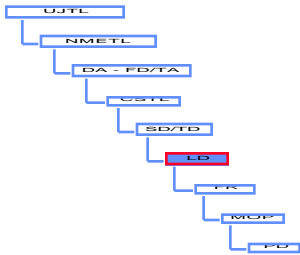
# Perform IFF Transponder Processing

## Inputs:

- 1. Damage.
  - Damage to the IFF transponder which may affect its performance.

- 2. Environmental Data.
  - Environmental conditions which may affect IFF transponder performance.

- 3. IFF On/Off.
  - Master power control switch to the IFF System.

- 4. Mode(s) On/Off.
  - Individual power control switches to each operational IFF mode (i.e., 1, 2, 3/A, 4, & C).

- 5. Encrypted Mode A/B Selection.
  - Manually selected encrypted Mode position that is selected at a designated daily time and/or prior to a mission.

- 6. IDENT Command.
  - Crew generated action in response to a voice communication requesting an IDENT. Crew commands the transponder to IDENT.

- 7. Selectable Code Setting(s).
  - Code(s) selected manually by system operators via thumbwheel selectors (i.e., Mode 1 and 3).

- 8. Interrogation.
  - External interrogation inquiries from surface or airborne stations that the IFF transponder will respond to with coded identification (all) and altitude signals (aircraft only).

- 9. Altitude (MSL).
  - Actual aircraft altitude (relative to mean sea level) information that is transmitted via Mode C transmissions in response to a ground station's interrogation. Most often used for air traffic control altitude deconfliction.
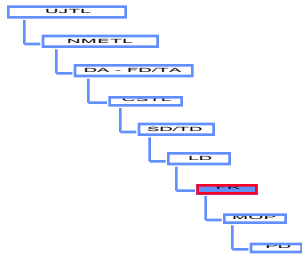
# Perform IFF Transponder Processing Controls:

- 1. Damage Effects.
  - The amount or extent that damage to the IFF transponder will affect its ability to receive, or respond to, interrogations.

- 2. Environmental Effects.
  - The amount or extent that the environment affects IFF transponder performance (these include weather, sea state, etc.).

- 3. Encrypted Code Keyed.
  - Encrypted code (i.e., Mode 4) set. In some instances, the code for the current day is set in position A and the code for the next day is set in position B. This is necessary to permit units which are incapable of "re-keying" to operate in missions which begin one day and end the next.

- 4. Non-Selectable Code Setting(s).
  - Specific, non-selectable platform identification code(s) set prior to the mission (i.e., Mode 2).

- 5. Repair Time.
  - Based upon damage effects or hardware failure, the expected time to repair the damage and restore the transponder to an operational status.

- 6. Reliability.
  - Mean time between failure data for the IFF transponder and its supporting hardware.

- 7. IFF System Attributes.
  - Characteristics of the IFF System, such as operating frequency, mode/code descriptions, interrogation ranges (per mode) and update periodicity.

# Perform IFF Transponder Processing

## Outputs:

- 1. Status / Casualty Report.
  - A report that indicates that the transponder is operational, or has suffered damage or equipment failure.

- 2. Interrogation Indications.
  - Internal ship or aircraft lights and displays to indicate interrogations are being received.

- 3. Response Emission.
  - These emmissions can be:
    - a. Automatic coded identification and altitude signals in response to interrogations from surface or airborne stations, or.
    - b. An Identification of Position (IDENT) reply selected manually by aircrew (switch is spring-loaded return). IDENT responses provide identification of position to Mode 1, 2, and 3/A for 20-25 seconds.

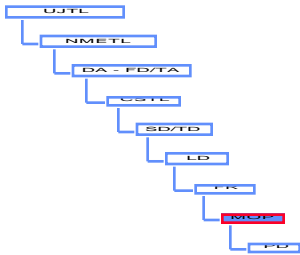# 2. Functional Requirements.

- Perform IFF Interrogator Processing
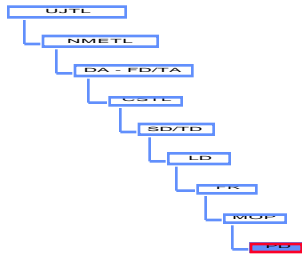- Perform IFF Transponder Processing

# Perform IFF Transponder Processing Functional Requirements (FRs)

- 1. The capability to power the IFF System as well as specific individual modes shall be provided.

- 2. The IFF transponder shall be capable of responding to proper external interrogation inquiries from surface or airborne stations with correctly coded identification and altitude responses.

- 3. The system shall have the capability to transmit an IDENT reply.

- 4. The ability to receive and respond to interrogations shall be appropriately impacted as a result of inactive modes, damage, reliability, and/or environmental effects.

- 5. The requirement to respond to an interrogation shall consider the sensitivity attributes of the transponder and the distance between the interrogation platform and the responding platform.

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# Perform IFF Transponder Processing Measures of Performance (MOPs)

- 1. The capability to power the IFF System as well as the specific individual modes shall be verifiable.

- 2. The effect of manual and mechanical mode settings and keys on the IFF System's ability to receive and respond to interrogations shall be verified.

- 3. The ability to transmit an IDENT reply in response to a controller's verbal request shall be verifiable.

- 4. The impact of inactive modes, reliability, damage, and/or environmental

- effects on the system's ability to receive and respond to interrogations shall be verified.

- 5. The effects of transponder response as a function of sensitivity as it relates to the distance between the interrogation platform and the responding platform shall be verifiable.

- 6. Appropriate indications of interrogation challenges shall be verified.
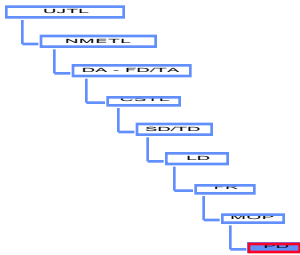
# IFF Preliminary Design

- The Preliminary Design for the Identification Friend or Foe (IFF) system provides a high level approach to implementation of the IFF system. Desired IFF model performance characteristics identified from an analysis of the IFF Logical Depiction resulted in several Functional Requirements (which were listed in order of relative importance). Subsequently, Measures of Performance were then identified to verify the IFF System model. The following design criteria are established to specifically address and restate (in the same order of relative importance) the Functional Requirements and Measures of Performance identified in the IFF System model Logical Depiction.

# IFF Preliminary Design

- Perform IFF Interrogator Processing
- Perform IFF Transponder Processing

# IFF Preliminary Design

- 1. The capability to power the IFF System as well as specific individual modes shall be provided.
    - a. The capability to turn the IFF transponder on and off shall be provided. If the IFF system is off, no code values shall be reported.
    - b. The capability to turn each mode of the IFF system (i.e., 1, 2, 3/A, C, 4) on and off shall be provided. If a mode is turned off, no code values shall be reported for that mode.

# IFF Preliminary Design

- 2. The IFF transponder shall be capable of responding to proper external interrogation inquiries from surface or airborne stations with correctly coded identification and altitude responses.
  - a. The capability to enter and report specific codes for the all applicable modes shall be provided. For example, the following would apply to BLUFOR:

    | Mode | 1st Digit | 2nd Digit | 3rd Digit | 4th Digit |
    |------|-----------|-----------|-----------|-----------|
    | 1    | 0 - 7     | 0 - 3     | N/A       | N/A       |
    | 2    | 0 - 7     | 0 - 7     | 0 - 7     | 0 - 7     |
    | 3/A  | 0 - 7     | 0 - 7     | 0 - 7     | 0 - 7     |
    | 4*   |           |           |           |           |

    - * Implementation non-specific with functionality to report No response / invalid response; valid blue response; and, valid non-blue response.
    - A similar mode/code description should be implemented for REDFOR or other types of IFF systems.
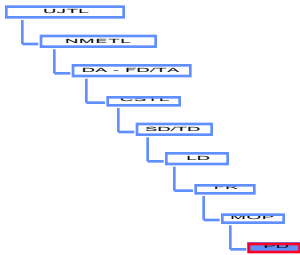  - b. The capability to determine and report altitudes, if applicable, shall be provided. For example, the following would apply to BLUEFOR:

    | Mode | Response |
    |------|----------|
    | C    | -1,000 to 127,000 Ft. MSL in 100 foot increments |

# IFF Preliminary Design

- 3. The system shall have the capability to transmit an IDENT reply in response to a controller's verbal request.

  - a. An IDENT reply shall be generated for each IDENT command.

- 4. The ability to receive and respond to interrogations shall be appropriately impacted as a result of inactive modes, damage, reliability, and/or environmental effects.

  - a. Response to interrogations shall be inhibited for transponder modes that have been rendered inactive.

  - b. The capability to turn a functioning IFF transponder off as a result of damage or material failure shall not be provided.

  - c. Functionality regarding the effects of environment shall not be provided.

# IFF Preliminary Design

- 5. The requirement to respond to an interrogation shall consider the sensitivity attributes of the transponder and the distance between the interrogation platform and the responding platform.
  - a. The capability for the transponder platform to consider the sensitivity attributes of the transponder and the distance between the interrogation platform and the responding platform to determine whether a response should be sent shall not be provided.
- 6. Appropriate indications that interrogation challenges have been received shall be accurately modeled.
  - a. Functionality regarding the indication of interrogations being received by the transponder shall not be provided.

# Note:

- Slide 70 through Slide 92 repeat Slide 38 through Slide 60 and will not be reprinted for this presentation.

BMH Associates, Inc.